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POTENTIAL ISSUES ASSOCIATED WITH PEAKING AND PONDING ON THE ST. MARY'S RIVER, MICHIGAN AND ONTARIO

INTRODUCTION

In response to a request from the International Join Commission (IJC), ERM has prepared the following report on potential ecological issues and concerns related to peaking and ponding operations at the hydroelectric facilities on the St. Mary's River (the River) operated by Edison Sault Electric Company (ESE) on the U.S. side and Great Lakes Power Limited (GLP) on the Canadian side. The International Lake Superior Board of Control (ILSBC) and Acres International Limited (working for ESE and GLP) submitted reports on peaking and ponding operations to the IJC in February 2002. These reports outlined the regulatory framework for peaking and ponding operations and the influence these operations have on flows and navigation in the River. These reports concluded that while peaking and ponding influence River levels and flows in the immediate vicinity of the generating facilities, these effects do not significantly affect the hydraulics of the St. Mary's Rapids (the Rapids) and the effects of peaking and ponding on flows and water level quickly diminish downstream of the generating facilities. Furthermore, the ILSBC report concluded that impacts of peaking and ponding are negligible below Rock Cut. While these documents contained thorough discussions of the effect of peaking and ponding on flows below the hydroelectric projects, they provided very little information on the potential impacts of peaking and ponding on natural resources in the River or on the ecology of the area.

In discharging its responsibilities for the St. Mary's River, the IJC wishes to identify all potential impacts that peaking and ponding may have on the River. To date, though solicited, the IJC has been unable to obtain much input from the resource agencies and other parties with management responsibilities for or an interest in the River.

This report provides additional detail on the potential impacts that peaking and ponding on the St. Mary's River may have on the ecology of the River, and on concerns that regulatory agency personnel and other interested parties have voiced regarding potentially sensitive species and resources that may be affected by these practices. During the preparation of this document ERM considered comments and information that the IJC and ERM received from agency personnel. The content of this report is not limited, however, to only those concerns voiced by the agencies. ERM also relied on its own prior experience with hydropower projects to evaluate the significance of those concerns and make suggestions on how those concerns should be addressed. This report does not address the effect of peaking and ponding on navigation, as that topic has been addressed in the above-mentioned reports prepared by Acres and the ILSBC.

Existing Information

In addition to various reports supplied by the IJC and Acres in response to the IJC's request for comments on peaking and ponding in the St. Mary's River and the effect of these operations on sensitive resources, the Chippewa Ottawa Resource Authority (CORA), Michigan Department of Natural Resources (MDNR), Ontario Ministry of Natural Resources (OMNR), Michigan Department of Environmental Quality (MDEQ), Sea Lamprey Control Centre (SLCC), and City of Sault Ste. Marie, Michigan submitted comments on issues and concerns they had regarding peaking and ponding in the River and its effect on natural resources in the region. ERM contacted personnel from MDEQ, CORA, MDNR, Great Lakes Fisheries Commission (GLFC), United States Army Corps of Engineers (USACE), and the SLCC directly to solicit further comments. ERM staff also reviewed the Atlas of the Spawning and Nursery Areas of Great Lakes Fishes (Atlas) compiled by the U.S. Fish and Wildlife Service (USFWS) in 1982 and accessed the Michigan Natural Features Inventory online to obtain State and Federal listed species known to occur in Chippewa County, MI. The most current inventory of listed species available for Chippewa County is from 1999. Therefore, the current state and federal status of species in Chippewa County that could potentially be affected by peaking and ponding should be confirmed.

Issue Summary by Resource Area

Spawning Habitat - Although the 1982 Atlas of the Spawning and Nursery Areas of Great Lakes Fishes is a relatively old information source, personnel from the MDNR noted that it remains the most complete collection of information of its kind for the region (personal communication with Dave Fielder, 4/1/02). According to the Atlas, at least 35 species of fish spawn in the St. Mary's River and of those species northern pike, lake whitefish, rainbow trout, white sucker, lake sturgeon, slimy sculpin, walleye, lake herring and sea lamprey spawn in the Rapids and in areas downstream of the generating facilities (Goodyear et al., 1982). The MDNR, CORA, MDEQ, and the SLCC all indicated in their comments to the IJC that they were concerned that peaking and ponding could have detrimental effects on spawning habitat. The agencies expressed concern that the variations in flow induced by peaking and ponding could increase sediment transport and deposition downstream, thereby reducing the amount of microhabitat available to spawning fish in downstream habitat areas, including the Rapids. Resource agencies also voiced concerns that varied flows also have the potential to redistribute eggs downstream, possibly exposing them to increased predation, redepositing them in areas where they would likely be smothered by deposited sediment, and/or redepositing them in areas that are not suitable for incubation. Studies by MDNR staff have documented drift of lake herring eggs in multiple areas in the River (Fielder, 1998); it is unclear what effect flows may have on the relocation of eggs of other species. As a general rule in the St. Mary's River the most intense spawning activity by desirable fish species takes place in the spring and fall. Occasionally, smallmouth bass will spawn through June, but during July and August the only species of concern to spawn in the St. Mary's River is the sea lamprey, an undesirable invasive ectoparasitic species. To the

extent that flows could be managed to facilitate spawning during the spring and fall and impede lamprey spawning during the mid-summer, regulation of flows could aid efforts by fisheries personnel to manage spawning fish stocks in the St. Mary's River (personal communication with Chuck Krueger, 4/3/02).

MDNR commented to ERM that the flow variation could have an impact on habitat and fish by 1) increasing sediment transport and 2) interfering with access under low flows by dewatering habitat. MDNR staff assumes this potential effect to be minor because of the short duration of low flows in the river (personal communication with Dave Fielder, 4/1/02). However, dewatering of nursery areas during low flows could have a significant effect on juvenile fish that are forced to move into the main channel and are therefore exposed to increased predation during ponding events.

Potential effects on spawning habitat would not be limited by season due to the temporal distribution of spawning activity by different species in the River. Previous studies have concluded that the effects of peaking and ponding do not affect water levels in the Rapids, therefore we do not consider peaking and ponding to have a significant impact on spawning habitat in the Rapids. We agree that there is some potential for adverse effects due to dewatering from the foot of the Rapids downstream to the vicinity of Rock Cut. We expect that the potential effects of sediment transport would be negligible for two reasons: 1) lack of a sediment source in the Rapids and/or passing the dam and lock works and 2) small variation in flows over 24-hour and 7-day periods compared with natural variation. Sediment transport tends to be proportional to flow for non-extreme conditions, therefore the fluctuations in flow seen in the St. Mary's River due to peaking and ponding are not expected to significantly increase or decrease sediment transport.

MDNR also assumes that potential velocity-related effects on most fish populations migrating to or from spawning beds would be minor because most of the species that use the Rapids are large species capable of swimming in strong flows (personal communication with Dave Fielder, 4/1/02). Depending on timing and fluctuation magnitude, however, peaking flows may affect smaller baitfish species' ability to complete their spawning migrations and could potentially have a cumulative effect on predatory fish stocks that rely on smaller species for forage. Because of the typically high fecundity of this group of fishes, and the multiple habitat types that they can occupy, we suspect that baitfish would adapt over time and render insignificant any overall effects on populations related to peaking and ponding operations.

MDNR staff recommended that if the IJC proceeds with its plan to monitor flows in the Rapids area during the coming year, that a monitoring station should be placed in the Rapids and data from that station should be compared with data from a study of benthic drift. Based on our previous experience, ERM is concerned about the practicality of flow monitoring within the Rapids. Flow monitoring depends on developing stage and discharge relationships, which would vary widely across the Rapids due to the morphology of the Rapids. Furthermore, we question the usefulness of such a study in the Rapids given that previous studies have concluded that the effects of peaking and

ponding do not affect water levels in the Rapids. We do, however, agree that some type of flow/drift analysis could yield valuable information on how changing flow patterns influence the redistribution of eggs and/or juvenile fish in areas downstream of the Rapids that have been mapped as important spawning areas if flow monitoring in those areas proved to be practical. MDNR staff further noted that flow models exist that can be adapted to predict the effect of different flows on fish eggs and that it would be appropriate to apply such a model to the St. Mary's River to determine the effect peaking and ponding may have on spawning fish in the River (personal communication with Dave Fielder, 4/1/02). A likely tool of utility is a simple 2-D hydrodynamic model of the River with I-P data (ichthyoplankton data) driven as passive particles to assess day-age class distributions over space and time as affected by the pulsing flows from peaking and ponding.

ERM has found that in most cases where peaking and ponding contribute to significant impacts to riverine habitat, river levels typically vary much more widely than they do on the St. Mary's River. While ERM considers the potential impacts of peaking and ponding on spawning habitat to be insignificant compared with naturally-occurring variation on the River, the potential for flow-related impacts still exist. Typically, this type of question is addressed using a habitat model, such as the PHABSIM component of the Instream Flow Incremental Methodology (IFIM) approach. This type of analysis predicts large-scale changes in available habitat from relatively small-scale fluctuations in flow. ERM used an IFIM (including the PHABSIM) analysis to describe this type of relationship and determine appropriate bypass flows and release patterns at the Oswego Falls Hydro Electric Project and used similar methodologies on the Black River and Hoosic River, all of which are in New York. This approach is highly sensitive to site-specific hydrological and biological parameters and channel morphology, and is particularly useful for areas of high biodiversity like the St. Mary's River because it can predict impacts to individual species and trophic guilds depending on how it is applied. We expect that some resource agencies will press the IJC for this type of analysis and wish to impress on IJC that data requirements to respond to such a request are not insignificant.

Wetlands - The extent to which peaking and ponding affects wetlands downstream of the hydroelectric projects is not clear; wetlands were not mentioned in agency comments to the IJC. However, personnel from the MDNR commented that high quality wetlands and aquatic macrophyte beds exist downstream in Lake Nicolet and around the shoreline of Sugar Island (personal communication with Dave Fielder, 4/1/02). The MDNR indicated that there are "considerable wetlands on the north west corner of Sugar Island" and that "this area is in the direct path and close proximity to the Soo Locks area"(email from Dave Fielder, 4/17/2002). Although the potential effects of peaking and ponding on these habitat areas are probably small due to the minor influence that peaking and ponding have on downstream water levels, MDNR staff noted that some of these wetland areas are important spawning and nursery habitats (personal communication with Dave Fielder, 4/1/02). Peaking and ponding could potentially affect the wetted perimeter in wetlands and aquatic macrophyte communities. Low water levels in the river during

ponding operations could desiccate wetland and/or macrophyte habitat on the upland or shoreward margins of these communities. Based on our analysis, the effect of peaking and ponding on water levels in this area would likely be overwhelmed by the effects of low water levels that occurred in this area recently as a result of the overall low water years in the Great Lakes region. Again, the magnitude and type of impact could be quantified using an IFIM or other approach, if needed.

ERM attempted to better define the location of these wetlands by querying the National Wetlands Inventory (NWI) through the U.S. Fish and Wildlife Service website. No data is available in the NWI for wetlands in Chippewa County, however the USGS 7.5 minute quadrangles for that area indicate that there are no wetlands between Sault Ste. Marie and Rock Cut. According to the USGS topographic maps, the closest wetlands to the hydroelectric facilities are on the southern tip of Neebish Island, downstream of the point where peaking and ponding have an appreciable affect on water levels. We also discovered that MDNR maintains a collection of GIS data that shows wetlands in the River. ERM further understands that the MDNR maintains databases with bottom contours and other geographical and hydrographical information for the St. Mary's River watershed. If the IJC wishes to pursue a more detailed analysis of the potential effects of peaking and ponding on wetlands, ERM recommends that IJC request MDNR to undertake a detailed inventory of their GIS data to identify high-quality wetlands with hydrologic connections to the River between the hydroelectric tailraces and Rock Cut and submit detailed, field-truthed maps of wetlands of concern to the IJC.

Threatened and Endangered Species - Resource agency personnel did not identify any threatened or endangered species potentially affected by peaking and ponding on the St. Mary's River. Lake sturgeon, however , which has been known to use the Rapids and areas downstream as spawning habitat is listed as threatened in Michigan. The lake herring, or cisco, is also listed as threatened in the state, although this species mainly uses areas downstream of the area affected by peaking and ponding. To the extent that peaking and ponding could affect wetland and aquatic macrophyte communities, these operations also have the potential to affect listed species that use these habitats such as the American bittern, a species with state special concern status in Michigan, and the piping plover, which is endangered in Michigan and listed as Endangered-Threatened federally. Both species were known to occur in Chippewa County (where the St. Mary's River is located) in 1999 (Michigan Natural Features Inventory, Michigan County Element List, accessed 3/26/02). Based on the predicted relatively minor hydraulic effect in the downstream areas, though, ERM projects that any habitat effects would be minor, if even measurable. These species are habitat opportunists as adults, and altered operations would not affect their range in the area.

Sediment transport - Although the MDNR and MDEQ have both expressed concern over loss of fish spawning habitat via increased sediment deposition as a result of peaking and ponding, (personal communication with Dave Fielder, 4/1/02, and e-mail from the DEQ to the IJC dated 3/18/02, respectively) no resource agency identified specific accretion areas in the St.

Mary's River downstream of the ESE and GPL facilities. Therefore it is not possible to determine whether erosion and/or accretion is currently having a detrimental effect on ecosystems in the St. Mary's River or if natural sediment transport mechanisms operating in the River are being altered significantly by regulation of the River's flow. As discussed earlier, while the potential effect on sediment transport is not zero, we expect that is would be insignificant, given the flow regime, geology, and morphology of the affected reach.

It should be noted that only slight changes in grain size or seasonal sediment deposition patterns can have significant effects on the suitability of potential spawning habitat for a wide range of fish species. ERM understands that the Detroit office of the U.S. Army Corps of Engineers maintains flow data and geometric data for the St. Mary's River. These data, in addition to the GIS data maintained by MDNR, could be used to model sediment transport, egg transport, and dewatering in the River under a variety of hypothetical or real flow conditions, thereby providing resource agency staff and the IJC an estimate of how peaking and ponding could be affecting the River currently and how potential changes in flow management on the River could affect natural resources there in the future.

Dams do not typically contribute increased sediment loads to areas downstream of the dam, although they do alter sediment transport patterns to varying degrees. Typically, sediment accumulates upstream of the dam, starving the downstream side. Northwestern Lake, impounded by the Condit Hydroelectric Project on the White Salmon River in Washington is an example of this phenomenon. We have found that typically where a hydroelectric dam is constructed at a natural or pre-existing grade control (such as the St. Mary's Rapids) the effect of that project on natural sediment transport is less than for dams that create new grade controls in the river. Effects on upstream sedimentation aside, we believe that the effect of peaking and ponding on sediment transport in the St. Mary's River is probably not significant or has reached an equilibrium state.

Sea Lamprey Control - In their comments to the IJC, the SLCC indicated that changes in water levels in the St. Mary's River as a result of peaking and ponding can have a negative effect on their efforts to trap adult lamprey. Fluctuating water levels can dewater the traps, and require frequent readjustment of the traps to ensure that the traps remain in the water. The SLCC asserts that readjustment of the traps is time-consuming and costly, and that more stable flows in the St. Mary's River would benefit them by reducing the effort and expenditure required to capture lampreys for their adult male sterilization program (e-mail to the IJC dated 1/14/02).

Although the SLCC indicated in their comments to the IJC that the water level fluctuations' impact on the adult trapping program is the most significant effect of peaking and ponding on their operations, they also communicated to the IJC and to ERM that changes in flow velocity in the St. Mary's River as a result of peaking and ponding affects lampricide treatment efficiency in the River. The Control Center currently uses granular Bayluscide, a product that consists of inert granular material coated with an active ingredient that is toxic

to lampreys. The product is broadcast over target areas and the active ingredient dissolves into the water as the product sinks. Low flows allow gentle dispersion of the product without transporting it outside the target area or over-diluting the application. Generally, treatments made during low flows are more effective than those made during high flows (personal communication with Larry Schleen, 3/29/02).

Enhancing lampricide treatment efficiency on the River can have a significant effect on the cost-effectiveness of lamprey control programs in the Great Lakes region - a single treatment of the entire St. Mary's River costs between $20-25 million and is repeated every 5 years (personal communication with Larry Schleen, 3/29/02). The St. Mary's River is the single largest recruitment area for sea lamprey in the entire Great Lakes basin, so lamprey control measures on the St. Mary's River can have a profound effect on sea lamprey populations throughout the basin.

St. Mary's River Remedial Action Plan (RAP) - In their comments to the IJC the CORA cited the St. Mary's status as an Area of Concern (AOC, a designation given by the IJC) and their involvement with the RAP process for the St. Mary's River AOC. In a personal communication with ERM, a representative for the CORA re-affirmed the agency's concerns as expressed in their comments to the IJC, including the St. Mary's River RAP (personal communication with Mark Ebener, 4/9/02). The current RAP, drafted in October 1998, cites ten impaired uses for the St. Mary's River AOC caused by "major point source discharges" and states "Loss of wetlands and rapids habitat due to urban/industrial development, and operation of navigational structures are also a concern" (St. Mary's River RAP, 1998).

The background section of the RAP asserts that point source effluent from wastewater treatment plants contribute significantly to impairment of the St. Mary's River, and the IJC has expressed concern that peaking and ponding may influence the assimilative capacity of the St. Mary's River. Assimilative capacity is a regulatory threshold defined (roughly, and varies by state) as a 7-day average low flow with a 10-year recurrence interval. Use of a defined low flow to define assimilative capacity has a basis in science, but is simply a regulatory threshold and is not necessarily indicative of a biologically significant threshold, but approaches a physically or chemically significant threshold for what regulators feel is an extended low flow event with significant recurrence probability. This could be an issue in the St. Mary's River as regulators attempt to balance flows between the lakes for other purposes, thereby affecting the "normal" flow statistics of the River used by regulators for assessing waste load allocations. Permits are written using this flow; flows managed to levels that would increase the likelihood of seeing flows indicative of 7Q10 (or similar) conditions would be an issue for water quality compliance — and therefore have some biological significance locally as well for high-water quality dependent species. In the case of a regulatory threshold, there is a presumption of protection, as long as the permit holder is in compliance with the permit.

The applicability of assimilative capacity to natural resource impacts

notwithstanding, peaking and ponding probably does not have a significant impact on assimilative capacity since peaking and ponding over the range and time frames cannot have a significant effect on the definition of the low flow. Because assimilative capacity is a function of the volume of water available to dilute or oxidize effluent under a specific event, only a major change in the duration of ponding to a longer period (rather than the 7-day period now used), or introduction of a consumptive use could result in a peaking or ponding-related impact on assimilative capacity. The potential for an effect is difficult to predict though, given that flows are abnormally low for the Great Lakes region generally, and the likelihood of a 7Q10-like event is greater now than ever.

Two habitat restoration and rehabilitation projects are currently included as part of the RAP: the Bar River Habitat Project and the Little Rapids Restoration Project. Assuming that these projects are fully implemented, ERM expects peaking and ponding to have similar impacts to those discussed above on the restored habitat areas as it does on habitat elsewhere in the River.

Summary and Recommendations

Based on correspondence between the IJC, ERM, and various resource agencies concerning potential ecological issues and concerns related to peaking and ponding operations on the St. Mary's River, the most significant concern is the potential for variation in flows to affect the spawning success of a variety of fish species in the River in the Sault Ste. Marie area, immediately downstream of the generating facilities. Although various resource agency personnel identified the potential effects of peaking and ponding on habitat in the Rapids as cause for concern, the effects of peaking and ponding have been shown to be limited to the areas downstream of the Rapids. ERM therefore does not consider peaking and ponding as it is currently practiced to have an effect on habitat within the Rapids. Potential impacts on spawning success downstream of the Rapids include loss of habitat through increased sediment accretion on spawning beds, dislocation of spawned eggs, and temporarily reduced access to spawning areas, although the effect of flow variation on access to spawning areas is thought to be minor and limited to forage species. Based on available information and interviews we believe that there is adequate data to evaluate habitat related-effects in a simulation model using a tool like the PHABSIM component of the IFIM methodology. We note the MDNR's recommendation that flow data from a monitoring station in the Rapids be used in conjunction with flow data to develop an estimate of the effect of flow variation on egg displacement. We recommend that potential studies of the potential effect of peaking and ponding on egg drift be limited to the spawning areas identified by the MDNR between the foot of the Rapids and Rock Cut be considered for study at this time.

Peaking and ponding could potentially affect wetlands downstream of the hydroelectric facilities, but there is currently no data to evaluate this effect. The MDNR maintains a GIS database that shows wetlands in this area and we recommend that the IJC use this information to guide any future studies on the effects of peaking and ponding on wetlands. To the extent that regulation of

flows affects habitats used by threatened and endangered species, peaking and ponding could impact these species, although specific areas where these effects may be occurring have not been documented. ERM projects that effects on wetlands and listed species would likely be minor due to the relatively minor water level fluctuations caused by peaking and ponding in downstream areas. It is also not clear what effect, if any, peaking and ponding has on sediment transport in the River as a whole, however some resource agency personnel feel that more research should be conducted on this matter. We believe that while there may be some effect it is probably negligible. We believe there are adequate data to at least perform a first-order assessment of this effect.

Peaking and ponding clearly has an impact on the adult sea lamprey trapping program administered by the Sea Lamprey Control Center, and can affect the efficiency of lampricide applications in the River. In general, efforts to control sea lamprey in the St. Mary's River and in the Great Lakes may benefit from a more stable flow regime and relatively low flows during lampricide applications. How significant these costs and benefits are compared with other alternatives requires additional investigation and coordination with the SLCC. Based on its review of existing reports, correspondence with resource agency personnel, and our own experience ERM does not believe that there are natural resource issues of sufficiently grave concern to suggest adjustment to peaking and ponding practices planned through March 20, 2003. It may become necessary, however, to address resource agency concerns through some focused analysis methods.

Next Steps

We recommend that the IJC consult with the SLCC to determine the cost/benefits of coordinating low flow events with scheduled lampricide applications. We also recommend that the IJC request that the MDNR and OMNR collaborate to develop a detailed statement of their concerns regarding effects on spawning, nursery, macrophyte, and wetland habitats in the area between the downstream boundary of the rapids and Rock Cut. The IJC should further request that the MDNR and the USACE provide any available GIS data on wetland locations and river morphology to help guide any proposed studies. We expect that the spawning, nursery, macrophyte and wetland areas will overlap significantly, and that identified areas of concern will be small. If the MDNR and OMNR provide a detailed description/inventory of wetlands and spawning/nursery habitats between the Rapids and Rock Cut that could be affected by peaking and ponding, it may be appropriate for the IJC to consider using an IFIM, PHABSIM or similar analysis depending on the available data and information needs to evaluate the effects of peaking and ponding on wetted perimeter (available habitat) and or water levels.

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